

---

# **PROPULSION DIRECTORATE**

## **Monthly Accomplishment Report November 2001**

---



| <b><u>Contents</u></b>   | <b><u>Page</u></b> |
|--|--------------------|
| <b><i>Lightcraft Sets New AFRL Altitude Record.....</i></b>                  | <b><i>1</i></b>    |
| <b><i>Transition of New Simulation Technology.....</i></b>                   | <b><i>1</i></b>    |
| <b><i>Combustion Researcher Honored .....</i></b>                            | <b><i>2</i></b>    |
| <b><i>VAATE Visionary Honored .....</i></b>                                  | <b><i>3</i></b>    |
| <b><i>Pulsed Detonation Engine Research Earns Award for Schauer.....</i></b> | <b><i>3</i></b>    |
| <b><i>Kudos for ATEGG Program Manager .....</i></b>                          | <b><i>4</i></b>    |
| <b><i>PR Active in Gaseous Electronics Conference .....</i></b>              | <b><i>5</i></b>    |

**LIGHTCRAFT SETS NEW AFRL ALTITUDE RECORD:** A new AFRL altitude record was set during recent testing of the laser-propelled Lightcraft. A 10-cm Lightcraft model was recently tested using a new launch stand at the High Energy Laser System Test Facility (HELSTF) at the White Sands Missile Range (WSMR) in New Mexico. The model was tested in configurations with both a silicon carbide shroud and with the standard aluminum shroud. Delrin propellant was used in the configuration with the aluminum shroud, while the configuration with the silicon carbide shroud used only air as the propellant. The new launch stand worked well, and several design changes were noted to further improve its operation. During this testing, the Lightcraft flew to an altitude of 180+ feet, significantly surpassing the previous AFRL record. The world record for Lightcraft altitude is 234 feet and is held by Lightcraft Technologies Inc. Plans are now underway to manufacture a 25-cm Lightcraft for further testing. The Lightcraft Program is exploring the futuristic concept of propelling a space vehicle into low-Earth-orbit (LEO) with a beam of laser light. This technology is envisioned as a low cost method for placing small satellites into orbit. (F. Mead, AFRL/PRSP, (661) 275-5929)



A Lightcraft model is shown mounted in its launch stand (top) and in flight (bottom)

**TRANSITION OF NEW SIMULATION TECHNOLOGY:** The Propulsion Directorate's Power Division (AFRL/PRP) has successfully transitioned an advanced modeling, simulation, and analysis (MS&A) technology that was developed under the Air Force Small Business Innovation Research (SBIR) Program. Members of the Electrical Technology and Plasma Physics Branch (AFRL/PRPE) and PC Krause & Associates have developed an MS&A architecture that enables numerous widely-used commercial engineering software packages to be directly linked in a time-domain simulation. The approach, Distributed Heterogeneous Simulation (DHS) Links, allows detailed models to be connected in order to perform simulations and analyses of complex integrated subsystems. The models can be distributed over networked computers to optimize execution time, increasing computational performance by several orders of magnitude over conventional techniques. The technology has been transitioned to the US Navy, with three DHS facilities purchased and implemented. The US Naval Postgraduate School in Monterey, California, and the US Naval

Academy in Annapolis, Maryland, will use their facilities as tools for research targeting design and analysis of large-scale integrated dynamic subsystems. The DHS installation at the Naval Surface Warfare Center in Philadelphia will be used to simulate and analyze the detailed dynamics of several next-generation propulsion, power, and weapons integrated subsystems in direct support of Navy surface ship programs presently in engineering and manufacturing development. (P. Lamm, AFRL/PRPE, (937) 255-6016)



A new DHS facility

**COMBUSTION RESEARCHER HONORED:** Dr. James Gord received the Exemplary Civilian Service Award on 26 October 2001 in recognition of his distinguished service as senior research chemist and Diagnostics, Sensors, and Fundamental Combustion Team Leader in the Propulsion Directorate's Combustion Science Branch (AFRL/PRTS) from 1 January 1999 to 5 July 2001. Dr. Gord develops advanced laser-based diagnostic techniques and applies them to the study and improvement of next-generation propulsion and fuels systems. His work is critical for achieving



Dr. James Gord

a detailed understanding of the fundamental chemistry and physics that govern combustion processes. In turn, this understanding is essential to the development and validation of computational models for designing state-of-the-art propulsion systems. In his role as team leader, Dr. Gord has designed, developed, and operated state-of-the-art facilities unique to the Air Force and unparalleled throughout the world for exploring fundamental combustion and fuels phenomena. These facilities include advanced laser-based diagnostics and experimental combustion and fuels rigs that provide unprecedented opportunities for exploring the chemistry and physics of advanced propulsion systems. Ultimately, Dr. Gord's laser techniques yield tangible benefits for military and commercial aviation such as improved engine performance, reduced pollutant emissions, and enhanced reliability, maintainability, and affordability.

Dr. Gord is an internationally known and respected member of the technical community. He is active in a variety of technical societies, has chaired numerous symposia, and has over 200 publications and presentations to his credit. He also serves as an Adjunct Associate Professor with the Department of Chemistry at Miami University (Ohio) and is a frequent participant in local programs to promote science to youth. (R. Hancock, AFRL/PRTS, (937) 255-6814)

VAATE VISIONARY HONORED: Mr. Jeff Stricker received the Exemplary Civilian Service Award on 26 October 2001 in recognition of his distinguished service as Assessment Group Leader, and later, Chief of the Propulsion Directorate's Engine Integration and Assessment Branch (AFRL/PRTA) from 24 March 1993 to 31 July 2001. Mr. Stricker performed studies that have become the foundation of long-range planning for the turbine engine community. In 1993, he was tasked with developing a follow-on technology effort to the Integrated High Performance Turbine Engine Technology (IHPTET) Program. This was a daunting task due to the significant goals for IHPTET, which encompass doubling engine thrust-to-weight and reducing production and maintenance costs by 35%. Mr. Stricker rose to this challenge by creating a new long-range vision for the turbine engine community based on engine affordability. This new initiative, termed the Versatile Affordable Advanced Turbine Engines (VAATE) Program, has become the foundation of the propulsion industry's technology investments beyond IHPTET. Mr. Stricker



Mr. Jeff Stricker

demonstrated outstanding leadership by forming a number of diverse teams of research experts and guided them through the complex process to create overarching goals, identify technical challenges, and quantify system payoffs for the VAATE effort. Mr. Stricker also worked tirelessly to gain widespread support for the VAATE Program. He actively participated in marketing VAATE to the aerospace industry and numerous government departments and agencies. As a result, corporate letters of support for VAATE have been received from five turbine engine companies and articles highlighting the VAATE Program have appeared in *Aviation Week and Space Technology* and *Flight International*. The program has also gained support up to the highest levels of the DoD. Mr. Stricker's efforts will have a lasting impact on the future of propulsion systems for the Air Force and the country as a whole. (R. Hill, AFRL/PRT, (937) 255-4100)

PULSED DETONATION ENGINE RESEARCH EARNS AWARD FOR SCHAUER: Dr. Fred Schauer received the Exemplary Civilian Service Award on 26 October 2001 in recognition of his distinguished service as the Pulsed Detonation Propulsion Technology Team Leader in the Propulsion Directorate's Combustion Science Branch (AFRL/PRTS) from 1 January 1999 to 5 July 2001. During this period, Dr. Schauer and his team produced a series of "R&D firsts" in the pulsed detonation engine (PDE) research community. Dr. Schauer made significant progress





Dr. Fred Schauer (top) and the in-house pulsed detonation engine (bottom)

in addressing the doubts of a skeptical scientific community that questioned the PDE as a viable propulsion system. Three significant accomplishments have quelled this skepticism and distinguished Dr. Schauer as a world leader in PDE development: (1) the validation of PDE performance through carefully measured and calculated specific impulse ( $I_{sp}$ ) values, (2) the ability to run a PDE for indefinite periods of time, and most importantly, (3) the detonation of liquid hydrocarbon fuels without excess oxygen. This third accomplishment will make the PDE a battlefield propulsion system able to run on standard military fuel (JP-8) and propel air vehicles from rest to speeds exceeding Mach 5. PDEs have great potential for application to missiles, unmanned aerial vehicles, and even manned aircraft. This work has also demonstrated that PDEs can produce very high  $I_{sp}$  values, and the clever use of off-the-shelf technology has indicated that PDEs can be made at a fraction of the cost of typical gas turbine engines. PDEs may even hold promise as a key component for inexpensive access to space. Dr. Schauer has been recognized by the scientific community nationwide for his groundbreaking work, and he has presented his test results and theories in invited lectures at several recent conferences. The remarkable progress made on PDEs is a testament to Dr. Schauer's inventiveness and contagious enthusiasm for his work. (R. Hancock, AFRL/PRTS, (937) 255-6814)

**KUDOS FOR ATEGG PROGRAM MANAGER:** Mr. Ron Glidewell received the Exemplary Civilian Service Award on 26 October 2001 in recognition of his distinguished service as the Advanced Turbine Engine Gas Generator (ATEGG) Program Manager in the Propulsion Directorate's Propulsion Branch (AFRL/PRTS) from 3 January 2000 to 30 April 2001. As ATEGG Program Manager, he was charged with executing a \$30 million annual budget to conduct all gas generator demonstrator engine testing in support of the Integrated High Performance Turbine Engine Technology (IHPTET) Program. The IHPTET Program is a national DoD and NASA program with the goal of doubling propulsion system capability by the year 2005. Under IHPTET, demonstrator engine testing is conducted for three classes of aircraft turbine engines: (1) turboprop/jet (fighters, bombers, and large transports), (2) turboprop/turboshaft (trainers, helicopters, and small transports), and (3) expendable (missiles and unmanned air vehicles). Over the past year, gas generator or core engine testing was conducted in support of the turboprop/turboshaft engines under the ATEGG Program. Design, hardware fabrication, instrumentation, and assembly activity was also underway in support of four gas generator tests planned in all three engine classes over the next year. Despite this flurry

of activity, Mr. Glidewell flawlessly executed his responsibilities. A key objective of demonstrator engine testing is technology transition to the user, and the ATEGG Program is critical to the two largest Advanced Technology Demonstration (ATD) Programs in AFRL. Mr. Glidewell's has played a key role in the critical process of transitioning affordable engine technology to the user. (R. McNally, AFRL/PRTP, (937) 255-2278)



Mr. Ron Glidewell

PR ACTIVE IN GASEOUS ELECTRONICS CONFERENCE:

The 54<sup>th</sup> Gaseous Electronics Conference was held at the campus of Penn State University from 9-12 October 2001. Members of the Propulsion Directorate's Electrical Technology and Plasma Physics Branch (AFRL/PRPE) presented two oral papers and one poster paper at this conference. The research topics covered at this conference included plasma processing of semiconductors, polymers, metals, nanotubes, and nanomaterials. Other

research areas included atmospheric pressure plasmas for environmental remediation. Although this is a topical conference of the American Physical Society (APS), inclusion of multidisciplinary applied research topics permits participation of industrial researchers and other engineering department faculty members as well. This year, electric propulsion was included as a new conference topic. As an added part of this conference, a laboratory tour of the Materials Research Institute was organized. This institute has received a center of excellence funding from NSF (National Science Foundation) and several other government agencies. This institute provides opportunity for collaborative research, which could be extremely valuable for nanomaterials, magnetics, and superconductivity research projects managed by the Power Division. Drs. Alan Garscadden (PR) and Bish Ganguly (PRPE) met with the institute's director, Prof. Carlo Pantano. He indicated that a potential teaming arrangement could be made either directly with the institute or through the AFOSR program managers who support some of their research. In the business meeting, Dr. Ganguly was elected to serve on the executive committee of the Gaseous Electronics Conference for 2002 through 2004. Altogether, four new members were elected to serve a two-year term. The other three new members are Prof. Akihiro Kono from Nagoya University, Japan; Dr. Jean-Paul Booth from Ecole Polytechnique, France; and Dr. Helen Hwang from NASA Ames Research Center. In this capacity, PR will serve to organize this APS-sponsored conference and hopefully help expand its scope. (B. Ganguly, AFRL/PRPE, (937) 255-2923)